

**COLORADO DEPARTMENT OF TRANSPORTATION  
INVITATION FOR BID**

DATE: June 27, 2002

BID NO. HAA 02-087 MM

Return all bids to:  
Colo Dept of Transportation  
Purchasing Office, Room 150  
4201 E. Arkansas Ave.  
Denver, CO 80222

**ALL QUESTIONS REGARDING THIS BID MUST  
BE DIRECTED TO CDOT PURCHASING AGENT**  
Purchasing Agent:  
Michael Moore  
303-757-9798 Fax 303-757-9669

***Note: Vendors dropping off bids in person must sign in at the CDOT Headquarters building front desk prior to submitting bids to the Purchasing Office. Vendors, please arrive at least 10 minutes before the bid-opening deadline to allow time for the sign in process.***

**Bids MUST be received in the Purchasing Office No Later Than: 1:30 PM August 28, 2002**

**FAX BIDS ARE NOT ACCEPTABLE**

Bid for **BULK MAGNESIUM CHLORIDE BASED DEICING CHEMICALS (29% Mg Cl<sub>2</sub> in solution with water and 27% Mg Cl<sub>2</sub> in solution with water)** per attached specifications. Delivery to be on as needed basis for the period from date of award through June 30, 2003 with four (4) one-year renewal periods at sole option of the CDOT. Prices must be firm through the first 12-month period. Requests for any proposed price changes after the first award period must be submitted, along with documentation supporting such change, to CDOT Purchasing a minimum of 60 days prior to the proposed effective date of such change. Only one request for price change will be allowed within a given award period. An Award/Price Agreement Supplement will be issued for each additional renewal period that CDOT selects. **All material must be bid on an F.O.B. Destination, Freight Paid basis to be considered.**

Exceptions taken by any bidder may cause a bid to be considered non-responsive. Exceptions will be allowed only if the basic requirements of the specification are essentially unaltered. The State will be sole judge of what constitutes an allowable exception.

One bid only may be submitted on one IFB. **Alternate bids meeting the minimum specifications may be submitted on a separate copy of the IFB in a separate sealed envelope.**

**Awards from this bid will be issued by zone per CDOT's Zone Map (35 zones). Zone Map may be obtained by contacting Michael Moore at 303 757-9798. CDOT reserves the right to make award in the best interest of the State.**

<b>Zone 1 -Magnesium Chloride 27%</b>	\$_____/Gallon		Formatted: French (France)
<b>Zone 1 -Magnesium Chloride 29%</b>	\$_____/Gallon		
	VISUAL	MECHANICAL	
<b>Zone 1 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 1 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 1 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 1 - Rental of Spray Bar Attachment</b>	\$_____/Month		
<b>Zone 2 -Magnesium Chloride 27%</b>	\$_____/Gallon		Formatted: French (France)
<b>Zone 2 -Magnesium Chloride 29%</b>	\$_____/Gallon		
	VISUAL	MECHANICAL	
<b>Zone 2 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 2 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 2 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 2 - Rental of Spray Bar Attachment</b>	\$_____/Month		
<b>Zone 3 -Magnesium Chloride 27%</b>	\$_____/Gallon		Formatted: French (France)
<b>Zone 3 -Magnesium Chloride 29%</b>	\$_____/Gallon		
	VISUAL	MECHANICAL	
<b>Zone 3 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 3 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 3 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 3 - Rental of Spray Bar Attachment</b>	\$_____/Month		
<b>Zone 4 -Magnesium Chloride 27%</b>	\$_____/Gallon		Formatted: French (France)
<b>Zone 4 -Magnesium Chloride 29%</b>	\$_____/Gallon		
	VISUAL	MECHANICAL	
<b>Zone 4 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 4 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 4 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month	
<b>Zone 4 - Rental of Spray Bar Attachment</b>	\$_____/Month		

<b>Zone 5 -Magnesium Chloride 27%</b>	\$_____/Gallon	
<b>Zone 5 -Magnesium Chloride 29%</b>	\$_____/Gallon	
	VISUAL	MECHANICAL
<b>Zone 5 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 5 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 5 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 5 - Rental of Spray Bar Attachment</b>	\$_____/Month	
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<b>Zone 6 -Magnesium Chloride 27%</b>	\$_____/Gallon	
<b>Zone 6 -Magnesium Chloride 29%</b>	\$_____/Gallon	
	VISUAL	MECHANICAL
<b>Zone 6 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 6 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 6 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 6 - Rental of Spray Bar Attachment</b>	\$_____/Month	
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<b>Zone 7 -Magnesium Chloride 27%</b>	\$_____/Gallon	
<b>Zone 7 -Magnesium Chloride 29%</b>	\$_____/Gallon	
	VISUAL	MECHANICAL
<b>Zone 7 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 7 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 7 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 7 - Rental of Spray Bar Attachment</b>	\$_____/Month	
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<b>Zone 8 -Magnesium Chloride 27%</b>	\$_____/Gallon	
<b>Zone 8 -Magnesium Chloride 29%</b>	\$_____/Gallon	
	VISUAL	MECHANICAL
<b>Zone 8 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 8 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 8 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 8 - Rental of Spray Bar Attachment</b>	\$_____/Month	
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<b>Zone 9 -Magnesium Chloride 27%</b>	\$_____/Gallon	

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<b>Zone 9 -Magnesium Chloride 29%</b>	\$_____/Gallon	
	VISUAL	MECHANICAL
<b>Zone 9 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 9 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 9 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 9 - Rental of Spray Bar Attachment</b>	\$_____/Month	

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<b>Zone 10 -Magnesium Chloride 27%</b>	\$_____/Gallon	
	VISUAL	MECHANICAL
<b>Zone 10 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 10 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 10 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 10 - Rental of Spray Bar Attachment</b>	\$_____/Month	

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<b>Zone 11 -Magnesium Chloride 27%</b>	\$_____/Gallon	
	VISUAL	MECHANICAL
<b>Zone 11 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 11 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 11 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 11 - Rental of Spray Bar Attachment</b>	\$_____/Month	

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<b>Zone 12 -Magnesium Chloride 27%</b>	\$_____/Gallon	
	VISUAL	MECHANICAL
<b>Zone 12 - Rental of 10,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 12 - Rental of 20,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 12 - Rental of 50,000 Storage tank</b>	\$_____/Month	\$_____/Month
<b>Zone 12 - Rental of Spray Bar Attachment</b>	\$_____/Month	

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<b>Zone 13 -Magnesium Chloride 27%</b>	\$_____/Gallon	
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Zone 13 -Magnesium Chloride 29%	\$_____/Gallon	
	VISUAL	MECHANICAL
Zone 13 - Rental of 10,000 Storage tank	\$_____/Month	\$_____/Month
Zone 13 - Rental of 20,000 Storage tank	\$_____/Month	\$_____/Month
Zone 13 - Rental of 50,000 Storage tank	\$_____/Month	\$_____/Month
Zone 13- Rental of Spray Bar Attachment	\$_____/Month	

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Zone 14 -Magnesium Chloride 27%	\$_____/Gallon	
	VISUAL	MECHANICAL
Zone 14 - Rental of 10,000 Storage tank	\$_____/Month	\$_____/Month
Zone 14 - Rental of 20,000 Storage tank	\$_____/Month	\$_____/Month
Zone 14 - Rental of 50,000 Storage tank	\$_____/Month	\$_____/Month
Zone 14 - Rental of Spray Bar Attachment	\$_____/Month	

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Zone 15 -Magnesium Chloride 27%	\$_____/Gallon	
	VISUAL	MECHANICAL
Zone 15 - Rental of 10,000 Storage tank	\$_____/Month	\$_____/Month
Zone 15 - Rental of 20,000 Storage tank	\$_____/Month	\$_____/Month
Zone 15 - Rental of 50,000 Storage tank	\$_____/Month	\$_____/Month
Zone 15 - Rental of Spray Bar Attachment	\$_____/Month	

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Zone 16 -Magnesium Chloride 27%	\$_____/Gallon	
	VISUAL	MECHANICAL
Zone 16 - Rental of 10,000 Storage tank	\$_____/Month	\$_____/Month
Zone 16 - Rental of 20,000 Storage tank	\$_____/Month	\$_____/Month
Zone 16 - Rental of 50,000 Storage tank	\$_____/Month	\$_____/Month
Zone 16 - Rental of Spray Bar Attachment	\$_____/Month	

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Zone 17 -Magnesium Chloride 27%	\$_____/Gallon
Zone 17 -Magnesium Chloride 29%	\$_____/Gallon

	VISUAL	MECHANICAL
Zone 17 - Rental of 10,000 Storage tank	\$_____/Month	\$_____/Month
Zone 17 - Rental of 20,000 Storage tank	\$_____/Month	\$_____/Month
Zone 17 - Rental of 50,000 Storage tank	\$_____/Month	\$_____/Month
Zone 17 - Rental of Spray Bar Attachment	\$_____/Month	

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Zone 18 -Magnesium Chloride 27%	\$_____/Gallon	
Zone 18 -Magnesium Chloride 29%	\$_____/Gallon	
	VISUAL	MECHANICAL
Zone 18 - Rental of 10,000 Storage tank	\$_____/Month	\$_____/Month
Zone 18 - Rental of 20,000 Storage tank	\$_____/Month	\$_____/Month
Zone 18 - Rental of 50,000 Storage tank	\$_____/Month	\$_____/Month
Zone 18 - Rental of Spray Bar Attachment	\$_____/Month	

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Zone 19 -Magnesium Chloride 27%	\$_____/Gallon	
Zone 19 -Magnesium Chloride 29%	\$_____/Gallon	
	VISUAL	MECHANICAL
Zone 19 - Rental of 10,000 Storage tank	\$_____/Month	\$_____/Month
Zone 19 - Rental of 20,000 Storage tank	\$_____/Month	\$_____/Month
Zone 19 - Rental of 50,000 Storage tank	\$_____/Month	\$_____/Month
Zone 19 - Rental of Spray Bar Attachment	\$_____/Month	

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Zone 20 -Magnesium Chloride 27%	\$_____/Gallon	
Zone 20 -Magnesium Chloride 29%	\$_____/Gallon	
	VISUAL	MECHANICAL
Zone 20 - Rental of 10,000 Storage tank	\$_____/Month	\$_____/Month
Zone 20 - Rental of 20,000 Storage tank	\$_____/Month	\$_____/Month
Zone 20 - Rental of 50,000 Storage tank	\$_____/Month	\$_____/Month
Zone 20 - Rental of Spray Bar Attachment	\$_____/Month	

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Zone 21 -Magnesium Chloride 27%	\$_____/Gallon	
Zone 21 -Magnesium Chloride 29%	\$_____/Gallon	
	VISUAL	MECHANICAL

Zone 21 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 21 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 21 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 21 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

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Zone 22 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 22 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL MECHANICAL

Zone 22 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 22 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 22 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 22 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

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Zone 23 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 23 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL MECHANICAL

Zone 23 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 23 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 23 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 23 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

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Zone 24 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 24 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL MECHANICAL

Zone 24 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 24 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 24 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 24 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

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Zone 25 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 25 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL MECHANICAL

Zone 25 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 25 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 25 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 25 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 26 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 26 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL

MECHANICAL

Zone 26 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 26 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 26 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 26 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 27 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 27 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL

MECHANICAL

Zone 27 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 27 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 27 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 27 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 28 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 28 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL

MECHANICAL

Zone 28 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 28 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 28 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 28 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 29 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 29 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL

MECHANICAL

Zone 29 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 29 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

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Zone 29 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 29 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 30 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

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Zone 30 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL

MECHANICAL

Zone 30 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 30 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 30 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 30 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 31 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

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Zone 31 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL

MECHANICAL

Zone 31 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 31 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 31 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 31 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 32 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

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Zone 32 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL

MECHANICAL

Zone 32 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 32 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 32 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 32 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 33 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

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Zone 33 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

VISUAL

MECHANICAL

Zone 33 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 33 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 33 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 33 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 34 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 34 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

Zone 34 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month  
VISUAL MECHANICAL

Zone 34 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 34 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 34 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

Zone 35 -Magnesium Chloride 27% \$\_\_\_\_\_/Gallon

Zone 35 -Magnesium Chloride 29% \$\_\_\_\_\_/Gallon

Zone 35 - Rental of 10,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month  
VISUAL MECHANICAL

Zone 35 - Rental of 20,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 35 - Rental of 50,000 Storage tank \$\_\_\_\_\_/Month \$\_\_\_\_\_/Month

Zone 35 - Rental of Spray Bar Attachment \$\_\_\_\_\_/Month

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*For bid items above, if vendor cannot supply a 20,000 or 50,000- gallon tank, please note alternate bid and price per location for alternate. Example: three 20,000 gallon tanks @ \$\_\_\_\_\_/month instead of one 50,000 gallon tank.*

All material shall meet the attached specifications. NO QUANTITIES ARE GUARANTEED ON THIS BID.

24-hour notice is required of all deliveries. Payment shall be by gallon from certified tickets. Vendor to invoice per line item.

When requested, vendor to supply and install the following pieces of equipment for the dispensing of chemicals:

10,000, 20,000 or 50,000 gallon polyethylene or steel tank. The tank(s) shall be fully equipped to transfer Magnesium Chloride from the storage tank to the truck and shall include the following:

1. All plumbing
2. All hardware
3. All wiring necessary for the proper function of tank.
4. Minimum 2 horsepower single phase 115/230 volt non-corrosive 50 G.P.M. pump
5. Over fill protection (**Separate bid for visual or mechanical means**)
6. Capacity gauge
7. Method of metering the product from storage tank

CDOT will prepare the site(s) for the storage tank(s) per vendor requirements.

The materials specified in this bid are those magnesium chloride based products that will not freeze above a temperature of +3°F in a 29% and -3 F in a 27% magnesium chloride solution with water (two separate products are specified for bidding purposes.

All material shall meet the attached specifications. **NO QUANTITIES ARE GUARANTEED ON THIS BID.**

All deliveries shall be per time agreed at placement of order. Payment shall be by gallon from certified tickets. Vendor is to invoice per line item.

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Unit prices (per gallon) must be given. Bids must be quoted FOB Destination to be considered.

Financial obligations of the State of Colorado payable after the current fiscal year are contingent upon funds for that purpose being appropriated, budget, and otherwise made available. EITHER PARTY MAY CANCEL UPON THIRTY (30) DAYS WRITTEN NOTICE.

Vendor is responsible for delivery to exact delivery location as determined in conjunction with the CDOT. Vehicles shall not be operated on any roadway in excess of the legal weight limitation. The contractor shall be responsible for any and all fines incurred for being overloaded as well as any other safety or moving violations. Overweight trucks will not be accepted or unloaded.

CDOT reserves the right to request samples prior to beginning deliveries. CDOT may also take random samples at any time. Material must meet specification. Samples will be tested in accordance with the enclosed specifications. CDOT test results will be the final authority in accepting/rejecting material.

All equipment must comply with city, county, state and DOT rules, regulations, requirements, etc. which apply. All operators must be properly licensed for the type of equipment being operated. The CDOT reserves the right to reject any improperly licensed equipment or operator.

By submission of a bid or quote, bidder agrees as follows:

Except as replaced, modified, or supplemented by CDOT for this solicitation, all items in the State of Colorado Solicitation Instructions / Terms and Conditions are considered part of, and are incorporated by reference into this document

Bidder testifies that bid prices were arrived at independently and there was no collusion involved.

The Bidder/Proposer/Vendor guarantees to the State that they understand and agree to the terms and conditions of this IFB and that they will not default from performance by virtue of a mistake or misunderstanding. Bidders shall seek clarification from CDOT Procurement of any specifications, terms and/or conditions that they determine to be unclear. The failure of a bidder to seek clarification may be deemed a waiver of any such clarification.

This award shall be available for use by CDOT, other State Agencies and Institutions (with approval from State Purchasing), Local Governments and Political sub-divisions in the state of Colorado.

Low, tie bids shall be decided in accordance with the provision of C.R.S. Section 24-103-202.5, as it currently exists or is hereafter amended, which gives a preference to resident bidders. Any bidder who wishes to be considered a "resident bidder" for purposes of the tie bid procedure provided in C.R.S. Section 24-103-202.5 shall include with their bid, proof that they meet the definition of resident bidder as set forth in either C.R.S. Section 24-103-101(6)(a) or C.R.S. Section 24-103-101(6)(b).

Pursuant to CRS 24-30-202.4 (as amended), the state controller may withhold debts owed to state agencies under the vendor offset intercept system for: (a) unpaid child support debt or child support arrearages; (b) unpaid balance of tax, accrued interest, or other charges specified in Article 22, Title 39, CRS; © unpaid loans due to the student loan division of the department of higher education; (d) owed amounts required to be paid to the unemployment compensation fund; and (e) other unpaid debts owing to the state or any agency thereof, the amount of which is found to be owing as a result of final agency determination or reduced to judgment as certified by the controller.

NO CHANGES TO THIS INVITATION FOR BID, OR A PURCHASE ORDER OR AWARD, WHICH MAY RESULT FROM THIS BID, MAY BE MADE EXCEPT IN WRITING FROM THE CDOT PROCUREMENT OFFICE. ANY OTHER CHANGE WILL BE NULL AND VOID AND WILL NOT OBLIGATE THE STATE IN ANY WAY.

It is expressly understood and agreed that the Vendor shall comply with all terms and conditions contained herein. Submission of a bid shall constitute Vendor's agreement.

**Chemical Delivery ARO**\_\_\_\_\_

**Payment Terms** \_\_\_\_\_

**Vendor Name**\_\_\_\_\_ **Signature**\_\_\_\_\_

**Address**\_\_\_\_\_ **Name (Print)**\_\_\_\_\_

**City, State, Zip**\_\_\_\_\_ **Title**\_\_\_\_\_ **Date**\_\_\_\_\_

**Vendor Phone**\_\_\_\_\_ **Fax**\_\_\_\_\_

**F.E.I.N/SSN**\_\_\_\_\_

**AWARD INFORMATION WILL NOT BE GIVEN BY PHONE. AWARD NOTICE WILL BE POSTED ON BIDS SYSTEM APPROXIMATELY TWO WEEKS AFTER BID OPENING.**

The following information is to be supplied by the bidder.

1. The product being bid is sold under the brand name of

\_\_\_\_\_

2. The product is manufactured by

\_\_\_\_\_

3. This product will contain \_\_\_\_\_ percent magnesium chloride

4. This product weight \_\_\_\_\_ pounds per gallon at the percentage indicated above.

5. This product can be stored for \_\_\_\_\_ days at \_\_\_\_\_ degrees Fahrenheit or warmer  
without precipitating out solids in excess of 0.3% by weight,  
and NO \_\_\_\_\_, Some \_\_\_\_\_, Moderate \_\_\_\_\_, or High \_\_\_\_\_ agitation  
or re-circulation is required to prevent product stratification.

## LIQUID MAGNESIUM CHLORIDE SPECIFICATIONS

### I. GENERAL SPECIFICATIONS

To bid a product, for the State of Colorado, vendors must be a registered member of the Colorado BIDS system to receive an award. Web address of the BIDS system is: [www.gssa.state.co.us](http://www.gssa.state.co.us). Click on the State Purchasing and Colorado BIDS icons.

Products must meet all of the specifications included herein.

Bidders must submit proof of testing by third party laboratories that show their products meet all specifications contained herein.

- A. No bids will be accepted on any products that contain constituents in excess of the following established total concentration limits as tested in accordance with the listed test methodology from Section VI. Results are stated as milligrams per liter (mg/L).

1. Total Phosphorous	25.000 mg/L
2. Cyanide	0.125 mg/L
3. Arsenic	5.000 mg/L
4. Copper	0.200 mg/L
5. Lead	1.000 mg/L
6. Mercury	0.050 mg/L
7. Chromium	0.100 mg/L
8. Cadmium	0.150 mg/L
9. Barium	10.000 mg/L
10. Selenium	0.300 mg/L
11. Zinc	10.000 mg/L
12. Ammonia	5.000 mg/L
13. Molybdenum	15.000 mg/L

- B. All products must be shown to be at least 70% less corrosive than sodium chloride to the mild steel metals specified in Appendix A, Test Method B.

No manufacturer or vendor may bid a corrosion inhibited deicer product unless qualified by successfully completing the National Association of Corrosion Engineers (NACE) Standard TM-0169 - 95 test as modified by PNS for deicer testing.

Note: The modified NACE Standard TM-0169-95 requires the use of 30 milliliters of 3% solution per square inch of coupon surface for corrosion testing.

- C. All products must also be shown to be no more corrosive than is sodium chloride to the following alloys:

Aluminum	2024
Aluminum	5086
Stainless Steel	410
Stainless Steel	304

The corrosion test method shall be as specified in paragraph B above. This corrosion test method is further modified requiring the test to be conducted for a period of **30** days on the alloys listed above.

- D. The supplier of any product delivered and/or applied, that is found to be contaminated with non-specified products and is cause for environmental concerns shall be responsible for all clean up expenses. This includes but is not limited to clean up measures as needed for the following: storage facility, yard, equipment, and roadside.
- E. The deicer contractor shall be liable, as determined by the purchaser for causing any unanticipated extraordinary damages to deicer equipment.
- F. The deicer must demonstrate an ice penetration ability of not less than ~~2~~ millimeters in a 30 minute period with not more than 3% standard error at a temperature of -9.44°C (15°F) using the Strategic Highway Research Project (SHRP) H-205.4 Test Method as documented in the SHRP Publication SHRP-H-332.

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## II. BID PROCESS

- A. Bids must be accompanied by an analysis, from a certified commercial laboratory, of the product to be supplied. See "Product Sample Checklist" below for complete instructions as to how to provide required information. Analysis must contain the following information for each type of product being bid. Failure to comply with this section may be cause for rejection of bid.
1. Corrosion test data from an independent laboratory obtained according to NACE Standard TM-0169-95 as modified by PNS for deicer testing.  
  
**Note: The modified NACE Standard TM-0169-95 requires the use of 30 milliliters of 3% solution per square inch of coupon surface for corrosion testing.**
  2. Analytical results of all constituents for which limits have been set by these specifications. (See General Specifications)
  3. Specific gravity chart (liquid magnesium chloride – 27% or 29% - complete with corrosion inhibitor as delivered) with correlating weight and freeze point information presented in 1% increments beginning with a 5 % solution. The chart must contain information up to, including, and exceeding, *by 5% (or the solubility limits of your product)* the concentration being submitted for evaluations.
  4. Physical specifications including detailed information on the corrosion inhibitor used in the product and minimum concentration of the corrosion inhibitor **MUST** be included with the bid document. Information must be sufficient in detail to address all specification requirements per contract terms.
  5. Information on the minimum corrosion control inhibitor concentration percentages and appropriate laboratory procedures for verifying concentrations must be included with the bid response per contract terms.
  6. **Confidential/Proprietary Information:** Any restrictions of the use or inspection of material contained within the within the proposal shall be clearly stated in the proposal itself. Written requests for confidentiality shall be submitted, by the offeror with the proposal. The offeror must state specifically what elements of the proposal are to be considered confidential/proprietary. Confidential/proprietary information must be readily identified, marked and separated/packaged from the rest of the proposal. Co-mingling of confidential/proprietary and other information is **NOT** acceptable. Neither a proposal, in its entirety, nor proposal price information will be considered confidential and proprietary. Any information that will be included in any resulting contract cannot be considered confidential.



- B. Bids MUST be accompanied with the most recent detailed product specification sheet and Material Safety Data Sheet (MSDS). All documents must be clearly legible.
- C. Most deicer products after successfully completing CDOT's required initial screening process and corrosion tests may then be required to successfully complete field application/effectiveness tests.
- D. Field application/effectiveness testing of some products may be waived based on the ingredients of the product. An example of this could be a formulation of a corrosion inhibited magnesium chloride product. CDOT has laboratory and field tested many variations of this product and results of field tests should be predictable based on ingredients and percentages of those ingredients. The option to waive field application/effectiveness tests lies solely with CDOT.
- E. Product samples and required documentation shall be submitted in accordance with the "Product Sample Checklist." All sample documents, including a copy of the completed checklist for each sample, must be clearly labeled to facilitate easy identification of sample documents.
- F. **All product information must be received in a timely manner as noted on "Product Sample Checklist." Failure to supply the required information in this section may be cause for disqualification.**

These test results will be used to establish a database for future fingerprinting of the product when delivered to any of the CDOT locations. Any products purchased in the future will be expected to meet specifications as established in the bid process. All test data that is submitted with is subject to verification by CDOT testing. Results of the testing from the state's laboratories shall be verifiable and final.

### III. FIELD DELIVERY OF PRODUCTS

- A. The bill of lading and invoice for each shipment must contain the following information:

1. Name of product.
2. Supplier and manufacturer of product.
3. Destination of delivery.
4. Order tracking number
5. Total number of units being delivered.
6. Total weight of delivery (certified scale ticket).
7. Lot number of product (products) being delivered. The lot number must enable purchaser to track a delivered product back to its manufacture point, date of manufacture, and specific batch.
8. Transport information--Name of transporting company, tank, trailer, or rail car number, point and date of origin.
9. For liquid products include the Percent Concentration and Specific Gravity.

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The invoice must include all of the above and the following information:

1. Order tracking number, each delivery
2. Contract unit of measure.
3. Contract unit price for product delivered.
4. Total price for units delivered.
5. A copy of the original bill of lading.

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**Deleted:** All orders will be placed by fax. The official order date shall be the date of the fax transmittal if received by the contractor before 2:00 p.m. (all order times reflect contractor time) and the next day if received by the contractor after 2:00 p.m. Contractor will fax back to the buyer a confirmation of receipt and an estimate of the order shipment date within 2 business hours. CDOT may, at its

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Dessert Mountain: Fax # 505-598-0436

[Paul@desertmtncorp.com](mailto:Paul@desertmtncorp.com)

[Brenda@desertmtncorp.com](mailto:Brenda@desertmtncorp.com)

- 2) The second section is reserved for the supplier to confirm product, quantity and delivery dates for the order placed by CDOT. The supplier should provide the requested information within 8 business hours (business day is defined as 8:00 a.m. to 5:00 p.m. Monday through Friday) and return the sheet to the CDOT email address or fax #, as provided in the first section of the form. The supplier will state the start and end dates for product delivery of the requested order. This information is requested as a large order may take several days to deliver and a realistic expectation of the delivery time frame is needed for planning purposes.

If the supplier confirms or requests a delivery time frame beyond that shown in the original order form and this new time frame is acceptable to CDOT, the original Order Tracking Number will be voided and a new order form with a new Tracking Number will be initiated to document the delivery time frame and price agreed upon. The applicable pricing to be used will be the next delivery day interval for the specific supplier. As an example, the Castle Rock patrol places an order on 12-1-08 with GMCO for Ice Ban product to be delivered in 2 calendar days at the GMCO pricing for the 2 day delivery time frame. GMCO is unable to deliver within 2 calendar days, but does confirm a delivery time frame of 4 calendar days. This is acceptable to the Castle Rock patrol and a separate order form is created with a new tracking number that reflects the new expected delivery date of 4 days (12-5-08), as well as the GMCO pricing for Ice Ban at the next delivery time frame interval of 7 days. The original order and tracking number are voided.

If the confirmation information regarding delivery dates and/or product quantity provided by the supplier is unacceptable or if confirmation is not given, the order may be cancelled by printing "VOID" across the form and either emailing or faxing a response back to the supplier. It is acceptable for the supplier to provide notification that an order request cannot be confirmed or filled and therefore is voided. Do not reuse an Order Tracking Number which has been assigned to a voided order.

- 3) The last section at the bottom of the form is for reporting of the actual delivery of product. All product delivered should be identified with the Order Tracking Number for every delivery. Deliveries should not be accepted unless the Order Tracking Number assigned at the time of order placement can be verified. Multiple entry fields are provided to record delivery of product when more than one load is delivered until an entire order has been completed.

If a sample is taken for testing purposes, this should be indicated in the Notes/Comments field along with the trucking firm making the delivery and date of test sampling. A copy of the order form should also be provided with the sample when transmitted to Staff Maintenance for testing. The Order Tracking Number should also be recorded on the "Deicer Chain of Custody" form that is submitted with the sample. Payment should be withheld on any delivery load sampled until notification of test results and any applicable penalties have been provided by Staff Maintenance. Any penalties assessed shall be deducted from the invoice for that order, based upon the order tracking number.

If an order is sampled, and the sample not tested, this will be reported and authorized for immediate payment.

- 4) Note to Suppliers – Invoices should be mailed to the address listed in the "Invoice in Triplicate" portion of the Purchase Order. All invoices shall list both the PO number and the Order Tracking Number. Suppliers must invoice within 30 days of order delivery and provide a monthly statement for each Invoice address.

## **H. Delivery Requirements**

- 1) The order confirmation, bill of lading and invoice documents for each shipment must reflect a tracking number designated by CDOT on the original "CDOT Deicer Product Order Form" which is unique to each order placed and consistent on all subsequent documents for each order. Product quantities will be ordered in full load increments of 4,500 gallons (i.e., 4,500; 9,000; 13,500; etc.). If any of these documents does not reflect the tracking number, the order will be deemed invalid and the load may be rejected or payment refused at the option of CDOT.

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All orders will be placed by fax or email using the “CDOT Deicer Product Order Form” and are required to be delivered within the ordering time frame for that product and supplier in that zone.

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The official order placement date shall be the date of the fax transmittal or email if received by the supplier before 2:00 p.m. and the next day if received by the supplier after 2:00 p.m. Monday through Friday, 8am to 5pm. The supplier will fax or email confirmation of the order back to CDOT indicating the confirmed delivery date and quantity to be delivered within 8 business hours. If the supplier confirms a delivery schedule later than that stated in the original product order form and this is acceptable to CDOT, payment will be made for the confirmed quantity at the price designated for the subsequent delivery period shown on the pricing page for the designated zone.

If the dates of shipment and/or quantity to be delivered as shown on the confirmation page are not acceptable to CDOT, the order will be canceled by returning the Product Order Form to the supplier with the word “VOID” written across the form within four business hours of receiving the confirmation. A subsequent order may be placed at CDOT’s option based upon discussion with the supplier regarding delivery details and requirements.

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## **I. Remedies**

Deliveries shall be made during normal working hours (Monday through Friday between the hours of 8:00 a.m. and 4:00 p.m.), unless otherwise requested or agreed to by purchaser. Any deliveries made without proper advance notification or outside of the established delivery times (unless otherwise authorized in advance) will be assessed an initial penalty of 10% of the purchase price of the product.

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All orders placed by CDOT, as per the procedure for order and confirmation described above. For ordered quantities of 9,000 gallons or more, a minimum of 9,000 gallons of product shall be delivered by the confirmed delivery date to the designated location, with an additional 9,000 gallons delivered each calendar day thereafter until the full order amount has been delivered. If the actual delivery date is later than the supplier’s confirmed delivery date, a deduction of **10%** per calendar day of delay will be reflected on the invoice submitted to CDOT for the affected daily product quantity (i.e., 9,000 gallons or lesser quantity as applicable).

If the supplier’s confirmed or actual delivery date of material exceeds the maximum allowable delivery time frame of 10 calendar days to any zone, a deduction of **10%** per day will be deducted by CDOT for each day of delay beyond the maximum allowable delivery time frame. This deduction will be made by CDOT for the affected daily product quantity (i.e., 9,000 gallons or lesser quantity as applicable).

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These deductions will be additive as applicable and will be deducted by CDOT from payments due to the supplier.

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### **EXAMPLE DELIVERY #1:**

A zone 11 order for 22,500 gallons of product is placed with GMCO for a delivery within 4 calendar days. The order is confirmed for delivery within 5 calendar days by the supplier. This delivery confirmation is acceptable to CDOT; however payment will be made at the reduced rate for the next lower pricing interval for a 10 calendar day delivery for zone 11 as per the pricing page for GMCO. Only 4,500 gallons of product is delivered on the 5<sup>th</sup> day; 9,000 gallons on the 6<sup>th</sup> day; and the final 9,000 gallons on the 8<sup>th</sup> day to complete the order quantity.

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The resulting penalties to be reflected by the supplier on the invoice for this order to CDOT are as follows. These penalties are assessed using the 10 day price for zone 11.

- 10% of invoiced price for 4,500 gallons not delivered on the 5<sup>th</sup> day
- 10% of invoiced price for 9,000 gallons not delivered on the 7<sup>th</sup> day

### **EXAMPLE DELIVERY #2:**

A zone 26 order for 13,500 gallons of product is placed with any supplier for delivery within 10 calendar days. The order is confirmed for delivery within 10 calendar days by the supplier. On the 12<sup>th</sup> day 9,000 gallons is delivered and on the 14<sup>th</sup> day the final 4,500 gallons is delivered to complete the order.

The resulting penalties to be reflected by the supplier on the invoice for this order to CDOT are as follows. These penalties are assessed using the 10 day price for zone 26.

- 20% of invoiced price for 9,000 gallons due to order delivery made two calendar days beyond the allowable maximum delivery schedule of 10 calendar days.
- 10% of invoiced price for 4,500 gallons not delivered on the 13<sup>th</sup> day

Penalties determined for late deliveries caused by what the supplier feels are “unreasonable or uncontrollable circumstances” shall be addressed with the respective CDOT Maintenance Superintendent and CDOT Purchasing within seven (7) calendar days of the occurrence. CDOT will provide a contact list of Maintenance Superintendents to awarded suppliers.

The late delivery fee assessment will be deducted from the payment of the invoice for the specific load of product not delivered according to the terms of this agreement. Consistently late deliveries may result in contract termination.

- J. Any assessments or deductions charged for improper notification and/or delivery will be accompanied with verification of order and delivery date.

#### IV FIELD INSPECTION, UNLOADING, SAMPLING, AND TESTING

BEFORE ALLOWING ANY PRODUCT TO BE UNLOADED, DEPARTMENT OF TRANSPORTATION PERSONNEL WILL ADHERE TO THE FOLLOWING PROCEDURES:

- A. INSPECTION- inspections will be limited by CDOT’s snowstorm response. CDOT reserves the right to waive this portion in these circumstances.
1. Document and maintain records on all deliveries, including those that are rejected.
  2. Check to assure that the product is being delivered according to the terms of the contract. This includes but is not limited to the following:
    - a. Date of the order.
    - b. Date and time of delivery.
    - c. Verification of advance delivery notification.
    - d. Delivered within allowable times.
    - e. Name of delivery company and license plate numbers.
    - f. Are any penalty assessments required?
    - g. Is the product being delivered what you ordered?
    - h. Document all procedures prior to unloading of product.
    - i. Verify that all papers required of a delivery are present, complete, and legible.
      1. Legible and current MSDS sheet.
      2. Certified weight slip (CDOT may waive during periods when weight scales are closed outside of normal business hours).
      3. Accurate, complete, and legible bill of lading and/or invoice with the information as required in Section III Part A.

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H. Deliveries shall be made during normal working hours (Monday through Friday between the hours of 8:00 a.m. and 4:00 p.m., unless otherwise requested or agreed to by purchaser. Any deliveries made without proper advance notification or outside of the established delivery times (unless otherwise authorized in advance) will be assess an initial penalty of 10% of the purchase price of the product. See “J” for details.¶

NOTE: Other charges (i.e. sales tax) if applicable will be adjusted to reflect the new purchase price when a penalty is taken as a reduction of purchase price.¶

I. Delivery shall be made on or within two (2) calendar days or less on all orders received by the contractor during the months of October through May and 15 days or less on orders placed d... [2]

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During the months of October through May, when orders larger than 10,000 gallons per location are placed, 10... [3]

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## B. UNLOADING

1. Visually inspect the load to determine if there are any obvious reasons why the load should be rejected.
2. Note the amount of product currently in storage prior to unloading.
3. Visually inspect the delivered product again while unloading. If problems are noted that are a cause for rejection of the load, halt the unloading process. Take photos if applicable and record any pertinent information. Conduct the following procedures if the material is to be rejected.
  - a. If material fails initial inspection or testing reload the product and reject the load.
  - b. If reloading cannot be done (mixed with previous material), note the amount of product (liquid only) pumped into the tank and total product now present in the tank.
  - c. Circulate the tank and then pull two one gallon (4 liter) samples of the contaminated deicer material now in the tank.
  - d. Check and record the specific gravity of the samples.
  - e. Take appropriate action as needed to assure the integrity of product on hand if possible. Will all products on hand have to be removed?
  - f. Submit samples to CDOT independent testing laboratory.
  - g. Immediately advise the Maintenance Superintendent of any ordering, delivery, storage, or product quality issues.

## C. SAMPLING AND TESTING

1. THE VENDOR IS TO SUBMIT A QUALITY CONTROL PLAN ALONG WITH HIS PROPOSAL (BID). The quality control plan will detail the interval of quality control testing, the quality control test location in the process and physical location of sampling, and the corrective action if material does not meet specifications.

All quality control sampling and testing are the sole responsibility of the vendor. Vendor to have third party certified testing done bi-monthly. Test results are to be submitted to the Maintenance Superintendent in each CDOT region that is placing orders. A complete quality control test of the magnesium chloride mixture will be in conformance with section VI. Samples must comply with the specifications as defined by CDOT.
2. Acceptance samples may also be taken by CDOT forces at the time(s) and location(s) of delivery. CDOT will take a minimum of one representative sample per location in accordance with standard CDOT practices and such samples will be tested in accordance with section vi, at an independent testing lab.
3. Delivered material must be clean and free of extraneous debris, awarded vendor is to verify that material does not become contaminated when loading and that material is loaded into clean trucks. In addition, the CDOT may also take random samples at any time. Vendor agrees that such CDOT sampling and testing procedures are a reasonable means to determine compliance with the specifications, and that the results of such procedures will be acceptable to determine compliance with the specifications provided that CDOT follows such procedures.

4. If an acceptance test fails to meet specifications, the vendor must show that he has taken appropriate action to remedy the problem, which caused the material to be out of specification before any further deliveries are made to the site(s).

Any acceptance sample, which fails to meet specifications, may be cause for immediate cancellation of the contract/purchase order for that location(s) at the option of CDOT. Cancellation does not affect any other rights the CDOT may have.

Prior to such cancellation, the vendor may be allowed one resample for retesting. If the resample is permitted, the vendor will be advised as to where and when the resample will be taken and is invited to meet CDOT forces at the time such resample is taken. Resamples may be split with the vendor who is free to obtain independent lab tests; however, the CDOT lab results will be the final authority for determining specification compliance.

## V DEICER CATEGORY

### Corrosion Inhibited Liquid Magnesium Chloride Specifications

In addition to the General Guidelines and Specifications, the following requirements also apply to liquid magnesium chloride deicer products.

1. Product must contain no less than 28% or 26% (depending upon product ordered) magnesium chloride.

Test Method: Number 1

2. Weight per gallon will be established according to the specific gravity and percentage of magnesium chloride contained in the product bid as indicated by the bidder.

Test Method: Number 2

3. Product will contain the corrosion control inhibitor in quantities not less than those indicated by the bidder. The finished deicing product, including corrosion inhibitors, must be completely accomplished at the original manufacturing plant location. Post adding of corrosion inhibitors or any other ingredients and splash mixing after the product has left the original manufacturing plant must have the prior approval of CDOT.

Test Method: Number 3

4. The pH must be 6.0 - 9.0.

Test Method: Number 4

5. This deicer shall not contain greater than 1.0% (V/V) Total Settle able Solids and shall have ninety-nine percent (99.0%) of the Solids Passing through a Number 10 sieve after being stored at -17.8EC+/-1EC(0EF+/-2EF) for 168 hours (seven days).

## VI TEST METHODS

### 1. Percent Concentration of Active Ingredient In The Liquid

Test Method: Atomic Absorption Spectrophotometry as described in “Standard Methods for the Examination of Water and Waste Water”, APHA-AWWA-WPCF. Test Method “A” in the Appendix “A” is used to determine percent concentration of Calcium Chloride or Magnesium Chloride.

### 2. Weight Per Gallon

Test Method: Specific Gravity by ASTM D 1429 Test Method A - Pycnometer at 20EC+/- 1EC.

### 3. Corrosion Control Inhibitor Presence and Concentration

Test Method: The Materials Laboratory may use the test procedures provided by the bidder or manufacture for testing quantitative concentrations of additives. These same tests can then be used to verify that materials being delivered are the same as those previously tested and approved in the bid process.

### 4. PH

Test Method: ASTM E 70 except a dilution shall be made of 1 part deicer to 4 parts distilled water before attempting a reading.

### 5. Corrosion Rate

Test Method: NACE Standard TM-0169-95 as modified by PNS. This procedure is listed as Test Method “B” in Appendix A.

This test method is further modified by CDOT *for only the aluminum and stainless steel alloys* specified in Section 1, paragraph C of these specifications. The test shall be conducted continuously for 30 days before the resulting corrosion levels are analyzed and reported.

### 6. Percent Total Settle able Solids and Percent Solids Passing a 10 Sieve

Test Method: This procedure is listed as Test Method “C” in Appendix A.

### 7. Total Phosphorus

Test Method: EPA 365.2 - EPA 364.4 is an acceptable test method as well. CDOT reserves the right to use either test method for periodic testing of delivered materials.

### 8. Total Cyanide

Test Method: Total Cyanide as described in “Standard Methods for the examination of Water and Waste Water”, APHA-AWWA-WPCF.



9. Total Arsenic, Barium, Cadmium, Chromium, Copper, Lead, Molybdenum, Selenium, and Zinc

Test Method: Atomic Absorption Spectrophotometry as described in “Standard Methods for the examination of Water and Waste Water”, APHA-AWWA-WPCF. EPA 200.7 is an acceptable test method for all metals except Chromium and Selenium – EPA 200.9 is an acceptable alternative test method for those two CDOT reserves the right to use either test methods for periodic testing of delivered materials.

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10. Total Mercury

Test Method: Cold Vapor Atomic Absorption Spectrophotometry as described in “Standard Methods for the examination of Water and Waste Water”, APHA-AWWA-WPCF. EPA 245.1 is an acceptable test method as well. CDOT reserves the right to use either test method for periodic testing of delivered materials.

11. Mill equivalents OR “meg”

Test Method: This is a measure of the amount of unreacted base in the product. “meg” means milliequivalents or the milligrams of acetic acid to neutralize 1 gram of unreacted base.

12. Moisture Content Of Solid Deicer Products

Test Method: According to ASTM E 534

13. Gradation

Test Method: According to ASTM D 632

14. Visual Inspection and Field Observations

Test Method: Visual inspection and field observations to assure that the material remains clean and free of extraneous matter, free from hard caking, does not segregate, and remains suitable for the intended purpose and as otherwise outlined in Section IV. NOTE: Purchaser may use any laboratory test method necessary to verify conclusions from visual inspections.

15. Ammonia: EPA 350.1 (Automated colorimetric phenate)

16. Freezing temperature – vendor shall supply CDOT with certification of actual freezing temperature of the material (29% or 27% Mg Cl<sub>2</sub> solution) complete with corrosion inhibitor, as delivered. The actual test is to be conducted via a third party laboratory and the lab can select the test protocol to ascertain the true freezing point of the material. The vendor shall fully document the testing protocol used.

## VII PENALTIES

### BASED ON MAGNESIUM CHLORIDE CONCENTRATION

Field samples taken of the delivered liquid deicer will be tested for Magnesium Chloride concentration in percent according to Test Method 1. The test results will be compared to the bidder quoted concentration (BQC) of deicer. Any element of compound that is not specific to the product being bid will not count towards BQC. For example, if a sample is submitted under the category of Magnesium Chloride, credit will be given for Magnesium Chloride content only. No credit shall be given for trace materials such as Calcium Chloride, Sodium Chloride, etc.

Evaluation and award of this solicitation will be based on the lowest, responsive, responsible bidder by Zone.

If the test results are out of specification, the supplier will be subject to a penalty based on the purchase price of the respective shipment as follows:

(At no time are any of the applied percentages allowed to reduce the concentration below the minimum concentration limit.)

#### Penalties for deicer below the minimum concentration are as follows:

##### For Concentration Ranges 29% $\pm$ 1%

27% to 27.9 %-----20% Penalty

26% to 26.9 %-----50% Penalty

24% to 25.9%-----75% Penalty

<24%- -----100% Penalty

##### For Concentration Ranges 27% $\pm$ 1%

25% to 25.9 %-----20% Penalty

24% to 24.9 %-----50% Penalty

22% to 23.9%-----75% Penalty

<22%- -----100% Penalty

NOTE: In the case of a storm event, buyer reserves the right to accept and use any concentration of product delivered and apply penalties as defined. This shall not be construed as CDOT's waiver of all other specifications and penalties.

**PENALTIES BASED ON METALS, PHOSPHORUS AND OTHER CONSTITUENTS AND CORROSION RATES.**

The constituent materials for which maximum levels are specified in these specifications shall have penalties assessed for all materials found to be in excess of the limits set forth in these specifications as follows:

0% to 20.9% over the specified limit -----	10% Penalty
21% to 39.9% over the specified limit -----	20% Penalty
40% to 74.9% over the specified limit -----	30% Penalty
75% to 99.9% over the specified limit -----	40% Penalty
100% to 199.9% over the specified limit -----	50% Penalty
200% to 300% over the specified limit -----	75% Penalty
Over 300% over the specified limit -----	100% Penalty

**Penalties are additive for each constituent found to be over the specified limit.**

**IX GENERAL PENALTIES**

Products, which fail to meet any of the other specification requirements (outside of acceptable range), will result in a 30% penalty assessment or total rejection as per the purchasers discretion. The supplier will be required to replace any rejected material plus any material that it contaminated at their cost. Any product that is rejected shall be removed by the supplier and replaced with product that meets the material specifications, including handling and transportation charges at no additional cost to the purchaser. Removal includes the removal of all material contaminated by the non-specification material if any. Purchaser's personnel will establish the amount of material contaminated.

Two shipments in any one zone per contract year of product found by purchaser to be beyond any acceptable range may result in contract termination.

In the state of Colorado, any penalties based on poor quality of the product delivered must follow these procedures:

2. Field sample taken at time of delivery and sent to CDOT or independent laboratory.
3. Sample tested and quality issues identified and documented.
4. Results are immediately sent to CDOT Maintenance Superintendent and Purchasing Agent.
5. Maintenance Superintendent and contractor will discuss the identified problem.
6. Implementation of penalties according to the contract/purchase order will be initiated.

**ADJUSTMENT MADE FOR OUT OF SPECIFICATION MATERIAL**

**ITEM I. GENERAL SPECIFICATIONS, section A.**

In the event that an acceptance sample is found to be out of specifications, heavy metals, the CDOT may:

1. Reject the delivered material and/or cancel the contract/purchase order after the 3<sup>rd</sup> occurrence.
2. Reject the delivered material and allow the vendor to make adjustments to his operation.
3. Where lab results are not known at time of delivery, penalties as specified above will be assessed based upon the lab results.

**Failure to deliver the materials in the specified time limit may, at CDOT's sole discretion, result in CDOT purchasing the required material from the next lowest bidder. The vendor shall pay the difference in cost between the two bid prices.**

## **APPENDIX A**

### **TEST METHOD "A" – Concentration Percentage of Active Ingredient In**

#### **Liquid Chemical Products**

### **TEST METHOD "B" – Corrosion Rate As Conducted From The NACE Standard TM-0169-95 As Modified**

#### **By The Pacific Northwest Snow fighters**

### **TEST METHOD "C" – Percent Total Settle able Solids And Percent Solids**

#### **Passing A No. 10 Sieve**

-  
-  
-  
-

## **TEST METHOD A**

### **Concentration Percentage of Active Ingredient In Liquid Chemical Product**

#### **I. Test Method**

Atomic Absorption Spectrophotometry as described in "Standard  
Methods for the Examination of Water and Waste Water", APHA-  
AWWA-WPCF

#### **II. Apparatus**

Atomic Absorption Spectrophotometer

250, 500 ml Graduated Cylinders

2000 ml Beaker

100, 500, 1000 ml Volumetric Flasks

5, 10, 15, 20, 25, 30 ml Volumetric Pipets

100 micro liter Eppendorf Pipet

### III. Reagents

ASTM D 1193 Type II Distilled Water

1000 ppm Calcium Solution made from an Analyzed Reagent Grade Chemical or a purchased Certified Stock Solution

1000 ppm Magnesium Solution made from an Analyzed Reagent Grade Chemical or a purchased Certified Stock Solution

Concentrated Hydrochloric Acid (HCl)

Concentrated Nitric Acid (HNO<sub>3</sub>)

Lanthanum Oxide (La<sub>2</sub>O<sub>3</sub>), Reagent Grade

#### IV. Preparation of Lanthanum Chloride, Calcium Chloride, Magnesium Chloride, Blank, and Quality Control Solutions Chloride, Calcium Chloride and Magnesium Chloride Solutions

##### 1. Preparation of Lanthanum Chloride

10% Lanthanum stock solution in a 2000 ml beaker add 200 ml of distilled water to 117.28 g of Lanthanum Oxide.

While stirring, **very slowly** add 500 ml of concentrated HCl (25 ml at a time).

**CAUTION!** This reaction is extremely violent. Care should be taken so solution does not overflow the beaker. When the solution has cooled to room temperature, transfer to a 1000 ml volumetric flask and dilute to volume with distilled water. (Lanthanum Chloride is the Ionization Suppressant used in determining Calcium and Magnesium concentrations by Atomic Absorption).

##### 2. Calcium and Magnesium Chloride Solutions

Calcium

- A. 100 ppm Calcium Stock Solution for Dilutions Using a volumetric pipet, measure 10 ml of

the 1000 ppm Calcium reagent solution into a 100 ml volumetric flask. Using an eppendorf

pipet add 0.1 ml concentrated HNO<sub>3</sub> acid and dilute to volume with distilled water.

- B. Calcium Standards for Calibration (20, 25, 30 ppm) Using volumetric pipets measure 20, 25, and 30 ml of the above 100 ppm Calcium stock solution into three different 100 ml volumetric flasks. Add 20 ml of the 10% Lanthanum Chloride solution to each flask and dilute to volume with distilled water.

## Magnesium

A. 100 ppm Magnesium Stock Solution for Dilutions Using a volumetric pipet, measure 10 ml of the 1000 ppm Magnesium reagent solution into a 100 ml volumetric flask. Using an eppendorf pipet add 0.1 ml concentrated  $\text{HNO}_3$  acid and dilute to volume with distilled water.

B. Magnesium Standards for Calibration (10, 15, 20 ppm) Using volumetric pipets measure 10, 15, and 20 ml of the above 100 ppm Magnesium solution into three different 100 ml volumetric flasks. Add 20 ml of the 10% Lanthanum Chloride solution to each flask and dilute to volume with distilled water.

### 3. Blank Solution

A. Blank Solution for Calibration Pipette 20 ml of 10% Lanthanum Chloride solution into a

100 ml volumetric flask and dilute to volume with distilled water.

### 4. Quality Control Solutions

A. Calcium Quality Control Check Weigh 0.6762 g pre-dried  $\text{CaCO}_3$  and place into a 1000ml volumetric flask. Add 1 ml concentrated  $\text{HNO}_3$  and dilute to volume with distilled water.

From this solution, pipette 10 ml into a 100 ml volumetric flask, add 20 ml of the 10% Lanthanum Chloride solution and bring to volume with distilled water. This will be the working Quality Control Standard and have a value of **27.10 ppm Calcium**. (Note: The 27.1ppm Calcium concentration is equal to a 30% brine concentration of Calcium Chloride based on a 2.5 gram sample size.)

B. Magnesium Chloride Quality Control Check Weigh 1.3341 g (nondried)  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$  and place into 1000 ml volumetric flask. Add 1 ml concentrated  $\text{HNO}_3$  and dilute to volume with distilled water. From this solution, pipette 10 ml into a 100 ml volumetric flask, add 20 ml of the 10% Lanthanum Chloride solution and bring to volume with distilled water. This will be the working Quality Control Standard and have a value of **15.95 ppm Magnesium**. Note: (Note: The 15.95 ppm Magnesium concentration is equal to a 25% brine concentration of Magnesium Chloride based on a 2.5 gram sample size.)

## **V. Preparation of Chemical Products Sample Solution**

### **Solution A**

1. Weigh approximately 2.500 grams of the liquid chemical product into a tared 500 ml volumetric flask. Record the sample weight to the nearest mg for final calculations. Add 1 ml  $\text{HNO}_3$ . Dilute to volume with distilled water. Label as solution A.

### **Solution B (Working Chemical Product Solution)**

2. Pipette 5 ml of Solution A into a 100 ml volumetric flask. Add 20 ml of 10% Lanthanum Chloride solution and dilute to volume with distilled water. Label as solution B (Dilution factor of 20).
3. Repeat Step 2 so that each chemical product sample has a duplicate working solution.

## **VI. Atomic Absorption Spectrophotometer Operation**

### **Calcium**

1. Set up the spectrophotometer (absorption) with the Calcium lamp using a wavelength setting of 422.4 nm, and a slit width of 0.2 nm. An Air-Acetylene flame should be used with the 10 cm burner head set at a  $45^\circ$  angle. The flame, burner, and instrument are to be optimized for best detection.
2. Calibrate the instrument using the blank, 20 ppm, 25 ppm, and 30 ppm standards for Calcium.
3. Run the Calcium Quality Control solution. This result must be within plus or minus 0.20 ppm of the known 27.10 ppm concentration before proceeding.
4. Once the Quality Control solution is within allowable limits, run the chemical product samples and their duplicates and record the results.
5. Run the Calcium Quality Control solution again to assure accurate results.
7. Following the analysis calculate the percent concentration of the sample and the duplicate sample for each chemical product using the following formulas. These test results must be repeatable within plus or minus 0.3% concentration of each other to be acceptable for reporting. If the results are outside this allowable limit, perform the dilutions over and retest until the samples are repeatable within the 0.3% limit.

## Magnesium

1. Set up the spectrophotometer (absorption) with the Magnesium lamp using a wavelength setting of 285.4 nm, and a slit width of 0.2 nm. An Air Acetylene flame should be used with the 10 cm burner head set at a 45°. The flame, burner, and instrument are to be optimized for best detection.
2. Calibrate the instrument using the blank, 10 ppm, 15 ppm, and 20 ppm standards for Magnesium.
3. Run the Magnesium Quality Control solution. This result must be within plus or minus 0.15 ppm of the known 15.95 ppm concentration before proceeding.
4. Once the Quality Control solution is within allowable limits, run the chemical product samples and their duplicates and record the results.
5. Run the Magnesium Quality Control solution again to assure accurate results.
6. Following the analysis calculate the percent concentration of the sample and the duplicate sample for each chemical product using the following formulas. These test results must be repeatable within plus or minus 0.3% concentration of each other to be acceptable for reporting. If the results are outside this allowable limit, perform the dilution's over and retest until the samples are repeatable within the 0.3% limit.

## VII. Calculations

Calculations for CaCl<sub>2</sub> base on a sample weighing 2.550 grams :

(20) (500 ml)

$$\text{Factor} = \frac{(110.99 \text{ CaCl}_2)(1\%)(\text{Dilution factor})(\text{Initial vol.})}{(40.08 \text{ Ca})(10,000 \text{ ppm})} = 2.7692$$

$$(40.08 \text{ Ca})(10,000 \text{ ppm})$$

$$\% \text{ CaCl}_2 = \frac{(\text{X ppm from AA})(\text{Factor})}{\text{grams of sample}}$$

grams of sample

$$\text{Example: } \frac{(28.20 \text{ PPM})(2.7692)}{2.5500 \text{ g chemical product}} = 30.6\% \text{ CaCl}_2$$

2.5500 g chemical product

Calculations for MgCl<sub>2</sub> base on a sample weighing 2.550 grams:

(20) (500 ml)



$$\text{Factor} = \frac{(95.211 \text{ MgCl}_2)(1\%)(\text{Dilution factor})(\text{Initial vol.})}{1000} = 3.9173$$

(24.305 Mg) (10,000 ppm)

$$\% \text{ MgCl}_2 = \frac{(\text{X ppm from AA})(\text{Factor})}{1000}$$

grams of sample

$$\text{Example: } \frac{(18.87 \text{ ppm})(3.9173)}{1000} = 29.0\% \text{ MgCl}_2$$

## TEST METHOD B

### Corrosion Rate As Conducted From The NACE Standard TM-0169-95 And As Modified By The Pacific Northwest Snow fighters

When these requirements are met the product is then subjected to the corrosion test. Based on PNS laboratory corrosion tests (National Association of Corrosion Engineers (NACE) Standard TM-0169-95, PNS modified), the corrosion inhibited chemical product must prove to have a corrosion value of at least 70% less than Sodium Chloride (salt) to be acceptable. **PNS has modified this procedure so that the test procedure uses 30 ml of a 3% chemical product solution per square inch of coupon surface area for the corrosion test.** (See special instructions below for corrosion testing of aluminum and stainless steel coupons.)

#### I. Preparation of the coupons

The coupons used are 1/2" (approximately 1.38 in. x 0.56 in. x 0.11 in.) flat steel washers displaying a density of approximately 7.85 grams per cubic centimeter. (Note: No galvanized coupons are allowed to be used even after removing the zinc with acid. Hot dipped galvanization creates a Fe-Zn metallurgical surface bond that changes the characteristics of the steel. Coupons must meet ASTM F 436, Type 1, with a Rockwell Hardness of C 38-45. Each coupons used in the test procedure is subjected to the following process to assure accuracy in test results. ▼

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- Wipe with suitable solvent to remove grease and oil.
- Examine each coupon for metallurgical abnormalities and reject those that are suspect to flaws.
- All coupons are tested for Rockwell Hardness of C 38-45; coupons having hardness outside of this range are rejected.
- Acceptable coupons are stamped for identification.
- Coupons are acid etched with 1 + 1 HCl for approximately 2 -3 minutes.

- The coupons are then quickly rinsed with tap water, distilled water, wiped dried and placed in chloroform.
- When the coupons are removed from the chloroform for use, they are place on a paper-lined tray (not touching each other) and allowed to air dry in a ventilated hood for a minimum of 15 minutes.
- Coupons are measured as specified. (Note: If latex gloves are not worn during measuring, the coupons should be rinsed again and dried as prescribe above prior to weighing. This will remove any oils that may be transferred to the coupons.)
- Each coupon shall be weighed to a constant weight. The constant weight shall be two consecutive weighings of each coupon within a minimum of 0.5 milligrams of each other. Removal of incidental flash rusting prior to weighing is not necessary.

Three coupons are used in each chemical product solution and for the distilled water and Sodium Chloride control standards.

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## II. MEASURING OF THE COUPONS

The outside diameter, inside diameter, and the thickness of each coupon is measured twice at 90 degrees from each initial reading and the averages calculated for each measurement. The averages are then used to calculate the surface area of each coupon with the following formula:

$$A = (3.1416/2)(D_2 - d_2) + 3.1416(t)(D) + 3.1416(t)(d)$$

Where D = average outside diameter

d = average inside diameter

t = average thickness

### Example:

$$A = (1.5708)(1.9044 - 0.3136) + 0.4768949 + 0.1935226$$

$$A = (1.5708)(1.5908) + 0.4768949 + 0.1935226$$

$$A = 2.4988286 + 0.4768949 + 0.1935226$$

$$A = 3.1692461 \text{ square inches (Total surface area of the coupon.)}$$

$$A = 3.17 \text{ square inches}$$

## III. Preparation of the Solutions

ASTM D 1193 Type II distilled water is used to prepare each solution, blank, and control standard. The Sodium Chloride (NaCl) used to prepare the salt standard shall be of "ANALYZED REAGENT GRADE" quality.

A 3% solution of NaCl is prepared by weight, using the reagent grade salt and distilled water.

A 3% solution of each chemical product to be tested is prepared using distilled water to dissolve and or dilute the chemical product. For liquid chemical products, three parts liquid chemical product (as received) is mixed with 97 parts distilled water to produce the test solution. If the chemical product is a dry product, then the 3% solution is made by weight.

All solutions including the distilled water blank are covered and allowed to sit a minimum of 12 hours to stabilize and reach equilibrium, ensure solubility and to account for any reactivity that may occur.

#### **IV. The Corrosion Test**

Approximately 300 milliliters (actual volume is determined by the surface area of test coupons) of each solution as mixed with distilled water and is put into a 500 milliliter Erlenmeyer flask. Each flask is equipped with a rubber stopper that has been drilled to allow a line to run through it. One end of the line is attached to a rotating bar and the other end of the line is attached to a plastic frame made to hold coupons inside the flask where three coupons are attached to each plastic frame. The rotating bar is controlled by an electric timer that lowers the bar for 10 minutes then raises the bar for 50 minutes out of the solution but still keeps the coupons inside of the flask for the entire duration of the test. This allows the coupons to be exposed to the test solution 10 minutes of each hour. The corrosion test is then run for 72 hours. No agitation of the solution is made during the corrosion test.

**Corrosion tests are conducted at normal room temperature. The room temperature is to be recorded daily during the operation of the test. The room temperature shall be taken with a calibrated thermometer located next to the corrosion-testing instrument. The temperature readings will be used to help determine varying corrosion rates, at this time temperature readings will not be used to correct data.**

#### **V. Cleaning of the Coupons**

The coupons are removed from the solution after 72 hours. They are placed into glass beakers containing the cleaning acid, concentrated hydrochloric acid (HCL) containing 50 grams/liter  $\text{SnCl}_2$  (stannous chloride) and 20 grams/liter  $\text{SbCl}_3$  (antimony trichloride). The two salts are added to the HCL to stop the reaction of the HCL with the steel once the rust or corrosion is removed. (Note: The fumes given off by the acid during cleaning contain gases formed from the antimony and are extremely hazardous, this portion of the cleaning must be conducted under a ventilated hood.)

After 15 minutes of cleaning the coupons are removed from the cleaning acid, rinsed with tap water and then distilled water, and wiped with a cloth to clean any deposit from the coupons. They are then returned to the cleaning acid and the procedure is repeated. After cleaning the coupons are rinsed in chloroform, air dried, and weighed.

Each coupon shall be weighed to a constant weight. The constant weight shall be two consecutive weighings of each coupon within a minimum of 0.5 milligrams of each other.

## VI. Evaluation of Corrosion

The weight loss of each coupon is determined by subtracting the final weight from the original weight. The corrosion rate for each coupon is expressed as mils penetration per year (MPY) by the following formula:

$$\text{MPY} = (\text{weight loss (milligrams)}) (534) / ((\text{area}) (\text{time}) (\text{metal density}))$$

**OR**

$$\text{MPY} = (\text{weight loss (milligrams)}) (534) \text{ divided by } ((\text{area}) (\text{time}) (\text{metal density})^*)$$

(Density is 7.85 g/cc for steel\*)

The final MPY value for each solution is determined by calculating an average of the three individual coupons. Average MPY from this point forward will be referred to as only MPY of the solution being tested. (Note: Wide variation of MPY of individual coupons inside the same flask typically indicates contamination of a coupon. If variation of individual MPY is too great to determine consistent data the test should be run over again. Typically coupon variation may run plus or minus 3 MPY.)

## VII. Explanation

To put the information into perspective it is necessary to briefly recap the corrosion test process. The corrosion value of the distilled water and the reagent grade sodium chloride is critical to this whole process. These are the two base lines used to determine a products acceptability in terms of corrosion value only.

In the table following the distilled water proved to have a corrosion value of 6.00 MPY. The chart shows that the reagent grade sodium chloride has a corrected corrosion value of 45.00 MPY. This means that the original corrosion value of the reagent grade sodium chloride and the distilled water (in a 3% solution) was 51.00 MPY. That is, 6.00 MPY for the distilled water and 45.00 MPY for the reagent grade sodium chloride. The 6.00 MPY value for the distilled water was subtracted from the original 51.00 MPY for the reagent grade sodium chloride and distilled water solution to arrive at the distilled water corrected value of 45.00 MPY for the reagent grade sodium chloride.

The corrosion value of 6.00 MPY for the distilled water is subtracted from the total MPY for each of the 3% solutions for each product tested. When this calculation is completed for each product being tested the resulting value indicates the corrected corrosion value.

According to criteria adopted by PNS; "Only corrosion inhibited chemical products that are at least 70% less corrosive than reagent grade sodium chloride may be used". To determine if a product is acceptable, take the corrected corrosion value of the reagent grade sodium chloride and multiply it by 30%. In this case, 45.00 MPY multiplied by 30% equals 13.5 MPY which is the highest acceptable corrected corrosion value for any product in this test. Any product in this test, that produces a MPY value higher than 13.5 MPY is rejected.

## VIII. Negative Numbers

Some products actually end up with a negative number as their corrected MPY value. A negative number is exceptionally good and it actually indicates that the product when mixed with distilled water in a 3% solution is less corrosive than distilled water.

To show an example of a negative number note that in Table 1 the distilled water in this test had a corrosion factor of 6.00 MPY. Also, note that the 3% solution of Wondermelt-A had a corrected corrosion value of -5.18 MPY. To quickly repeat the math used to arrive at this negative number the 3% solution corrosion value of 1.18 MPY, had subtract from it the distilled water corrosion value of 6.00 MPY. This resulted in the corrected MPY value of -5.18. The larger the negative number, the better a product is in terms of corrosion inhibiting abilities.

## IX. REPORTING RESULTS

Results shall be reported in Percent Effectiveness. Percent values equal to or less than 30% are passing. The distilled water corrected values of the chemical product and the salt are used to make this calculation. The corrected value of the chemical product is divided by the corrected value of the salt, this value is then multiplied by 100 to give percent.

Example: Magic Melter II has a corrected value of 10.15

Salt has a corrected value of 45.00

Therefore:  $(10.15 / 45.00) \times 100 = 22.6\%$  Pass

Acme Melter has a corrected value of 19.99

Therefore:  $(19.99 / 45.00) \times 100 = 44.4\%$  Fail

## Special instructions for corrosion testing of aluminum and stainless steel coupons:

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### DENSITY AND CALCULATIONS

First the density of each of the specific metals will be needed to do the calculations. I got these numbers from ASTM G1.

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Aluminum 2024 - 2.78  
Aluminum 5086 - 2.66

Stainless Steel Type 304 - 7.94  
Stainless Steel Type 410 - 7.70

The time will need to be modified to fit the 30-day test. The equation to calculate the Mils Per Year has changed in the factor that was previously stated in the NACE and PNS protocols. The equation should now be as follows:

$MPY = ((\text{Mass Loss})(534.57)) \text{ divided by } ((\text{Area})(\text{Time})(\text{Metal Density}))$

Mass Loss is in milligrams

Area is in square inches

Time is in hours

Metal Density is in grams/cubic centimeter

### **COUPON PREPARATION FOR ALUMINUM AND STAINLESS STEEL**

The coupons shall be degreased using a suitable solvent such as toluene, acetone, or methanol.

Examine each coupon for metallurgical abnormalities and reject those that are suspect to flaws.

**The coupons are to be abraded using a No. 120 abrasive paper or cloth, or the equivalent. Coupons of different alloy compositions should never be ground on the same cloth. Wet grinding should be used on the stainless steel due to its ability to work harden the surface easily.**

After abrading, the coupons should be scrubbed using a bleach free scouring powder followed by a thorough rinsing in distilled water. After washing the coupons should be dried then acid pretreated using the following method for each of the specific metals.

#### **Aluminum Acid Pretreatment**

The Aluminum coupons should be soaked for a 5-minute period in a 70% (V/V) solution of Nitric Acid. Following the acid cleaning the coupons shall be rinsed thoroughly with distilled water, dried and placed into chloroform.

When the coupons are removed from the chloroform for use, they shall be placed on a paper-lined tray (not touching each other) and allowed to air dry in a ventilation hood for a minimum of 15 minutes. During that 15-minute period the washers should be turned over once to allow for both sides to dry adequately.

#### **Stainless Steel Acid Pretreatment**

The Stainless Steel coupons should be soaked for a 15-minute period in a 10% solution of Nitric Acid. Following the acid cleaning the coupons shall be rinsed thoroughly with distilled water, dried and placed into chloroform.

When the coupons are removed from the chloroform for use, they shall be placed on a paper-lined tray (not touching each other) and allowed to air dry in a ventilation hood for a minimum of 15 minutes. During that 15-minute period the washers should be turned over once to allow for both sides to dry adequately.

## Coupon Cleaning Methods For After The Testing Is Completed.

### Aluminum

The coupons are removed from the solution after the 30-day time period. They are placed into glass beakers containing a 70% (V/V) concentration of Nitric Acid. The coupons are to be soaked for a period of 10 minutes. Following the acid cleaning the coupons are to be tap water rinsed followed by a light scrubbing with a nylon bristle brush. The coupons are to be rinsed with distilled water, dried and replaced back into the Nitric acid and the process repeated. After the second cleaning cycle the coupons are to be dried off, rinsed in chloroform, air-dried and weighed. Each coupon shall be weighed to a constant weight. The constant weight shall be two consecutive weights of each coupon within a minimum of 0.5 milligrams of each other. (Note: The fumes given off by the acid during cleaning are hazardous, this portion of the cleaning must be conducted under a ventilated hood.)

### Stainless Steel

The coupons are removed from the solution after the 30-day time period. They are placed into glass beakers containing a 10%(V/V) concentration of Nitric Acid, which is heated to a temperature of 60°C (140°F) for a period of 30 minutes. Following the acid cleaning the coupons are to be tap water rinsed followed by a light scrubbing with a nylon bristle brush. The coupons are to be rinsed with distilled water, dried and replaced back into the heated Nitric acid and the process repeated. After the second cleaning cycle the coupons are to be dried off, rinsed in chloroform, air-dried and weighed. Each coupon shall be weighed to a constant weight. The constant weight shall be two consecutive weights of each coupon within a minimum of 0.5 milligrams of each other. (Note: The fumes given off by the acid during cleaning are hazardous, this portion of the cleaning must be conducted under a ventilated hood.)

**TABLE 1**

**CHEMICAL PRODUCTS CORROSION TEST RESULTS**  
**ALL VALUES ARE DISTILLED WATER CORRECTED**

<b>MILS/YEAR</b>	<b>PRODUCT</b>		<b>REMARKS</b>
	<b>PERCENTAGE</b>		
*Super Stuff	-0.03	-0.07	Good stuff.
*Ice Melter	0.035	0.08	Good
*Magic Melter	1.00	2.22	Smells good
*Magic Melter II	10.15	22.55	OK
Acme Melter	19.99	44.42	Nice appearance
Acme Melter-1	23.71	52.69	50% @#*&^
Wondermelt	54.07	120.16	Very corrosive
*Wondermelt -A protection	-5.18	-11.51	Good corrosion
Stuff	17.00	37.78	not so good
SALT	45.00	100.00	
Distilled Water	6.00	13.33	

\* ACCEPTABLE PRODUCT

**NOTE:** The results used in the above table are for example only, and they are not firm numbers. The MPY corrosion values of the distilled water and the reagent grade sodium chloride may vary from test to test.



## TEST METHOD C

### Percent Total Settle able Solids and Percent Solids Passing on a No. 10 Sieve

This test method is used to determine the amount of total settle able solids and the percent solids passing on the No. 10 sieve that are generated from a liquid chemical product when stored at a specified cold temperature without agitation.

Settle able Solids for this procedure are typically formed from chemical precipitation, chemical crystallization, or by the dense settlement of any other components of the deicing product.

Chemical precipitates are formed when specific chemical constituents within the liquid chemical product react together chemically.

Chemical crystallization begins to form when a solution is cooled below its chemical saturation point. Crystallization is the physical characteristic by which a liquid begins to turn to a solid. This physical characteristic is typically used to identify the freezing point of a liquid. This test will determine if the deicing solution can maintain its liquid state at the supplied concentration and at the specified testing temperature with no agitation.

The settlement or separation of additional component(s) (i.e. inhibitors) of the product will be examined for the formation of a dense solid layer and the ability of the chemical product to maintain a non-stratified suspension without agitation.

Total settle able solids will consist of all described parameters excluding soft settling stratification as outlined in the test methodology.

Percent Solids Passing on the No. 10 Sieve will be measured by subtracting the volume of solids retained on the sieve from the total sample volume.

#### I. Apparatus

1-Liter Graduated Imhoff Cone

ASTM E 11 No. 10 sieve

Rubber policeman

Graduated cylinder

Watch glass

#### II. Test Method

Place 1000 ml of a well-mixed (non-diluted) liquid chemical product into a graduated one-Liter Imhoff cone. Place this sample into a freezer, which has been precalibrated and stabilized to the correct specified temperature as established in each liquid chemical product category. Cover the sample with a watch glass. The sample shall remain in the freezer unagitated for a period of 168 hours. Record the temperature of

the freezer daily to assure proper testing temperature. After 168 hours the sample is carefully removed from the freezer for testing.

#### 1. Total Settle able Solids

This test method will be used to determine if the liquid chemical product is usable and if it requires agitation. It will determine the detrimental amount of settlement formed from chemical precipitation, chemical crystallization, or by the dense settlement of any other component(s) of the deicing product.

The formation of chemical precipitation and/or chemical crystallization above the prescribed limit is cause for rejection. These characteristics are observed by a dense formation of precipitate and/or crystals in the cone. Various levels of crystallization may be present if the chemical product concentration is at or near its freezing point.

The settlement of other chemical product components that produce a dense solid layer above the prescribed limit will be cause for rejection. Stratification of material exhibited by phase separation or exhibiting a soft settlement is not to be interpreted as a dense solid layer. This type of separation is a result of the chemical product not staying homogenous through the test conditions. Samples submitted that exhibit stratification but pass all other specifications will be passed and will be categorized as "Requires Agitation".

The time used to evaluate each sample should be kept to a minimum because as the deicing solutions warm the physical characteristics within the solution change

Remove the sample contained in the Imhoff cone from the freezer. Determine readings as soon as possible because sample temperature begins to rise immediately after being removed. Measure and record the volume of settle able solids using the calibrated gradations on the cone. (Note: If the settled matter contains pockets of liquid between large settled particles, estimate the volume of these and subtract them from the volume of settled solids.) For transparent liquids the determinations are easily determined by directly reading the volume of the settle able solids in the bottom of the cone. For liquids that are not clear due to hazy, cloudy or opaque solutions or to indefinite stratified zones use the following method.

Place the sample in a room with no light. Then using a light capable of producing a concentrated beam, such as a flashlight with adjustable light features back light the sample. With this procedure determine the amount of settlement in the bottom of the cone and the phase separation interfaces. Record the settlement value and the stratification interface volumes if present.

To determine if this settlement is a dense formation or soft settling due to a phase separation use an eight-millimeter diameter solid glass rod of sufficient length to reach the bottom of the cone. The rod diameter should allow the rod to be inserted to the bottom of the cone and large enough so as to be able to determine the slightest resistance. Gently insert the rod into the chemical product and gradually lower the rod to the bottom of the cone. If resistance is felt, mark the rod level at the top of the cone and remove. Place the rod on the outside of the cone with the mark even with the top of the cone. Read and record the volume where resistance was felt from the gradations on the cone that correspond to the tip of the rod. This volume reading is to be interpreted as a dense settlement and must not exceed the specification limit. If the rod goes completely to the bottom of the cone with no resistance record that no dense settlement was found.

If stratification is present, hand stir the chemical product in a clockwise direction for 45 revolutions in one minute to see if the sample will re-homogenize. Examine the chemical product again, with the light if necessary, to determine phase stratification interface levels remaining, if any. Record new levels if present. If no levels are detectable and the solution is returned to a homogenous state exhibiting no stratified layers the chemical product will be marked "Requires Agitation". If levels of stratification are still present, mark as "Requires Extreme Agitation."

The total settle able solids volume shall consist of the accumulated amounts of chemical precipitation, chemical crystallization, and the dense portion of any other constituents. The total settle able solids are reported in percent based upon the volume to volume (V/V) ratio of the settle able solids to the initial sample size.

## 2. Percent Solids Passing the 10 Sieve

This procedure must be conducted as fast as possible after determining the total settle able solids so that any frozen chemical crystalline materials are adequately evaluated.

Immediately after determining the total settle able solids inverted the cone (or remove the tip on

some models) and pour the sample through an ASTM E 11 certified Number 10 sieve. The sieve should be kept in a mixture of ice and water to keep it cold before using and between samples. Rinse the sieve with water to remove any traces of the previous sample prior to placing in the ice bath. Before using the sieve briefly shake excess water from the sieve. The sample should be poured through one-quarter section of the sieve if possible to reduce the surface area from which the sample must be retrieved. The sample on the sieve is not rinsed or pushed through the sieve by any means. All material not flowing through the sieve is rubber policed from the sieve into a graduated cylinder and the volume measured and recorded. Rubber police only the side of the sieve the material was place on to pass through. Material that is trapped in the mesh of the sieve and does not come loose on the face of the sieve is considered passing and is not included. This volume is subtracted from the total volume of the sample to calculate the sample volume passing. The solids passing the No. 10 sieve are reported in percent

based upon the volume to volume (V/V) ratio of sample volume passing to the initial sample size.

**APPENDIX B**

**PRODUCT SAMPLE CHECKLIST**

**The bidder is required to fill out the following information for each sample submitted. This includes approved products and samples submitted for qualification testing. Failure to provide the following information is cause for the rejection of a bidders material. If more than one sample is submitted please make a copy of the required sheets and send them in with your samples.**

**Bidder Information**

Vendor Name \_\_\_\_\_ Signature \_\_\_\_\_  
Address \_\_\_\_\_ Name(print) \_\_\_\_\_  
*City, State, Zip* \_\_\_\_\_ *Title* \_\_\_\_\_ *Date* \_\_\_\_\_  
*Vendor Phone* \_\_\_\_\_ *Fax* \_\_\_\_\_  
*F.E.I.N/SSN* \_\_\_\_\_

**Product Information**

Bidder's response to the following items will be considered representative of their product. During testing of the bid samples, submitted samples cannot deviate from the percent concentration by more than minus one full percentage of the bidder quoted concentration as indicated below. If the bid samples exceed this deviation tolerance, that bid will be disqualified. If the bidder is bidding an approved product, they must indicate the Percent Effectiveness that their product qualified at for approval. (Note: The submitted Percent Effectiveness will be compared to the approved product test results for verification. If different, the qualification results will be used to determine the "final best buy factor".) It is to the bidder's advantage to have the submitted sample match as exactly as possible to the Bidder Quoted Concentration and the Percent Effectiveness for liquids and the Percent Effectiveness for solids as applicable. At no time will any sample be allowed to be below the minimum concentration requirement for that product as stated in these specifications. Failure to supply any part of this information is cause for rejection.

1. The product being bid is sold under the brand name of \_\_\_\_\_
2. The product is manufactured by \_\_\_\_\_
3. This product will contain \_\_\_\_\_ percent magnesium chloride
4. This product weighs \_\_\_\_\_ pounds per gallon at the percentage indicated above.
5. This product can be stored for \_\_\_\_\_ days at \_\_\_\_\_ degrees Fahrenheit or warmer without precipitating out solids in excess of 0.3% by weight, and NO \_\_\_\_\_, Some \_\_\_\_\_, Moderate \_\_\_\_\_, or High \_\_\_\_\_ agitation or recirculation is required to prevent product stratification.
6. Third party testing documentation for all specifications \_\_\_\_\_
7. Specific gravity chart with correlating weight and freeze point information \_\_\_\_\_
8. Two each one gallon container size samples of the product included  
\_\_\_\_N/A\_\_\_\_\_
10. Chemical analysis of the supplied samples is included as required.  
\_\_\_\_\_
11. Analytical results of all chemical constituents \_\_\_\_N/A\_\_\_\_\_
12. All required information on the corrosion inhibitor, including the verification process \_\_\_\_\_
13. Proprietary information labeled as such \_\_\_\_\_
14. Material Safety Data Sheet (MSDS). \_\_N/A\_\_\_\_\_
15. Ice penetration test results. \_\_\_\_\_
16. Samples and associated paperwork submitted to the following address this date; Indicate month, day and year.  
\_\_\_\_N/A\_\_\_\_\_
17. Quality Control Plan; Yes\_\_N/A\_\_\_\_\_ No \_\_\_\_\_
18. Have you included all the required information into the bid package?  
Yes \_\_\_\_N/A\_\_\_\_\_ No \_\_\_\_\_

All orders will be placed by fax. The official order date shall be the date of the fax transmittal if received by the contractor before 2:00 p.m. (all order times reflect contractor time) and the next day if received by the contractor after 2:00 p.m. Contractor will fax back to the buyer a confirmation of receipt and an estimate of the order shipment date within 2 business hours. CDOT may, at its own discretion, waive the fax process and place orders by telephone.

- H. Deliveries shall be made during normal working hours (Monday through Friday between the hours of 8:00 a.m. and 4:00 p.m., unless otherwise requested or agreed to by purchaser. Any deliveries made without proper advance notification or outside of the established delivery times (unless otherwise authorized in advance) will be assess an initial penalty of 10% of the purchase price of the product. See "J" for details.

NOTE: Other charges (i.e. sales tax) if applicable will be adjusted to reflect the new purchase price when a penalty is taken as a reduction of purchase price.

- I. Delivery shall be made on or within two (2) calendar days or less on all orders received by the contractor during the months of October through May and 15 days or less on orders placed during other months. This time limit shall be 24 hours in Zones 11 and 18. In the event the contractor fails to deliver within two calendar days as required, on day 3 or 16, a 10% late delivery penalty will be assessed. An additional 2% penalty per day will be assessed for each day of delay beginning with day 4 or 17 (depending on month of order) and continuing until delivery is made.

During the months of October through May, when orders larger than 10,000 gallons per location are placed, 10,000 gallons of that order must be delivered within the 2 day time period or penalties will apply. If the contractor can not deliver the entire order at once, the balance must be delivered in a minimum of 5,000 gallon quantities on a daily basis beginning immediately after the first delivery or as agreed to by the purchaser. This section does not prohibit delivery of an entire order at one time or any other delivery schedule that exceed the conditions of this contract.

Penalties assessed for late deliveries caused by what the contractor feels are "reasonable or uncontrollable circumstances" shall within seven (7) calendar days be addressed with the respective CDOT Maintenance Superintendent. The Maintenance Superintendent may notify CDOT Purchasing with specifics of problem and estimate of penalty. CDOT Purchasing will review and work with the Maintenance Superintendent for action and final determination of penalty if any.